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Significantly Reduced Leg Length Discrepancy and Increased Femoral Offset by Application of a Head–Neck Adapter in Revision Total Hip Arthroplasty

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ABSTRACT

Head–neck adapters in total hip arthroplasty (THA) promise the reconstruction of optimal femoral offset and leg length in revision THA while retaining stable implants. Radiological parameters after adapter implantation in THA revision were determined in 37 cases. Significant reduction of leg length discrepancy and improvement of femoral offset ($P < 0.001$) were found. Clinical endpoints were determined in 20 cases (mean follow-up 4.0 years). Clinical scores were rather poor (median Harris hip score 54, WOMAC score 41) due to age and comorbidities, postoperative dislocation occurred in 3 cases. Only one stable femoral stem had to be revised due to recurrent postoperative dislocation. In conclusion, a head–neck adapter can be a valuable tool in certain cases of revision THA with acceptable dislocation rates while allowing the retention of stable implants.

During the past two decades modular hip prostheses have been widely established in total hip arthroplasty (THA). The advantage of increased intraoperative flexibility to accommodate different femoral and acetabular geometries and deformities with a minimal inventory [1–5] seems to outweigh the disadvantages of possible dissociation [1–7] or even breakage [8] of the modular components or possible interfacial fretting corrosion [1,9–12]. In revision THA a modular adapter that mates with both the femoral stem and the modular femoral head is useful to restore preoperative biomechanics and soft tissue tension when the femoral or acetabular component shall be retained.

With different lengths (10.5–21 mm) and different angulations (neutral and 7.5°) the Merete® Bioball® adapter (see Fig. 1) was developed to optimize the femoral anteversion, femoral offset, and leg length to avoid unnecessary removal of an otherwise well fixed femoral component. It is thus used in patients with recurrent hip dislocation to increase both leg length and femoral offset while retaining the acetabular and femoral components, and in patients with partial revision of the acetabular or femoral component to accommodate the subsequent changes of soft tissue tension and biomechanics. This head–neck adapter system can be used with any stem with a standard 12/14 or 14/16 taper, modular heads are available in different materials (ceramic, metal) and sizes (28 mm–58 mm).

To our knowledge this is the first study to investigate if the Merete® Bioball® adapter achieves the goal of optimal leg length, femoral offset, and soft tissue tension in patients with revision THA. To this end, we evaluated the results after implantation of the head–neck adapter with regard to both radiological parameters (leg length discrepancy, femoral offset) and clinical variables (clinical scores, dislocation rate, specific complications).

Materials and Methods

Patients

We analyzed all cases of revision THA with implantation of the Merete® Bioball® adapter between 2004 and 2009. Thus, we included 40 patients with 44 surgical procedures in our study. Twenty-six patients were female, 14 patients were male. On average 2.5 surgical procedures of the ipsilateral hip (range 1 to 7) had been performed before implantation of the adapter. Mean age at the time of surgery was 71.0 years (range 38.7–90.5 years). In 37 cases (34 patients) preoperative and postoperative radiographs (pelvic a.p. and Lauenstein) of sufficient quality were available to determine preoperative and postoperative leg length discrepancy and femoral offset. Due to their advanced age and comorbidities a large number of patients were lost to follow-up. Only 18 patients (20 cases) were able to participate in the follow-up examination of this study (follow-up 4.0 years, range 2.0–6.7 years).

Indications for surgery in the 20 cases (18 patients) available for follow-up were loosening or dislocation of the cup (n = 11), recurrent dislocation of the THA (n = 6), conversion from hemiarthroplasty to THA (n = 2), removal of periarticular ossifications (n = 1), or loosening of both cup and stem (n = 1, see table 1). In all cases revision of head and inlay as well as implantation of the adapter was carried out, an elevated rim inlay was used in 5 cases. The adapter

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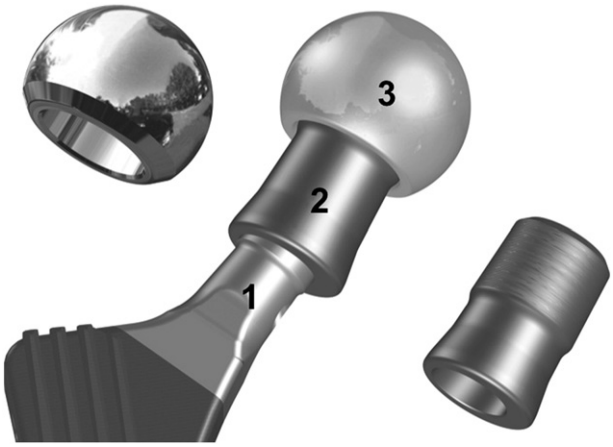

Fig. 1. Merete® Bioball® adapter. The adapter (2) mates with both the femoral stem (1) and the modular femoral head (3). © Merete Medical.

and neutral femoral head were manually assembled and fixed to the taper of the femoral component with several adequate hammer blows. The length of the femoral neck was exclusively determined by the length of the adapter and varied according to individual circumstances (see table 1). In 12 cases the adapter was 7.5° angulated to allow for additional lateral offset. In 13 cases revision of the cup and in one case revision of both cup and stem were performed additionally. In all cases metal heads sized 32 mm (n = 17) and 28 mm (n = 3) were implanted.

Data Gathering and Statistics

To evaluate the outcome after implantation of the head–neck adapter we analysed both radiological (radiographs available in 37 cases) and clinical (20 cases available for follow-up) parameters.

Radiological endpoints were leg length discrepancy and femoral offset measured preoperatively and postoperatively on a.p. radiographs of the pelvis according to Patel et al [13] as shown in Figure 2A–D. Clinical endpoints included dislocation rate, general complications (e.g. infection, loosening) and specific complications (e.g. dissociation or excessive wear of the adapter) as well as results of clinical questionnaires (Harris hip score, WOMAC score). In the 18 patients available for clinical follow-up the position of retained implants was noted (anteversion and inclination of the cup, anteversion and height of the stem). Adapters retrieved during revision surgery were inspected macroscopically, but were not available for scanning electron microscopy. The study design was approved by the university ethical committee (Application No. 119/11).

For statistical analysis the Statistical Package for Social Sciences (SPSS® Inc., IBM, version 19) was used. Continuous normally distributed variables were summarized as mean including minimal and maximal range, continuous non-normally distributed variables as median including minimal and maximal range. Percentages were rounded off to the first decimal. When comparing preoperative and postoperative radiological parameters paired Wilcoxon-Test was used for non-normally distributed parameters, paired Student's t-test for normally distributed score values. Shapiro–Wilk-Test was used to test for normality. A probability value of less than 0.05 was considered to indicate statistical significance.

Results

Radiological Endpoints

There were substantial reduction of leg length discrepancy and increase in femoral offset after implantation of the adapter (see Figs. 3A and 4A). The difference between the preoperative (median 3.0 mm) and the postoperative (median 0.0 mm) leg length discrepancy reached statistical significance ($P < 0.001$; paired Wilcoxon-test; see Fig. 3B).

The femoral offset of the ipsilateral hip was markedly improved after implantation of the adapter (see Fig. 4A). There was a significant difference between the preoperative offset (mean 5.8 mm) and the

Table 1
Clinical Details of the 18 Patients (20 Cases) Who Were Evaluated Clinically and Radiologically.

								Position of Retained Implants			
	Age	Gender	Prev. Surg.	Indication for Surgery	Adapter Size	Additional Implants	Complications	AT Cup	Incl. Cup	AT Stem	Height Stem
1	66.4	female	4	cup dislocation with osseous defect	2XL/7.5°	cup				suff.	neutral
2	71.3	female	2	cup loosening	3XL	cup + elevated rim inlay	septic loosening + removal of implants			suff.	high
3	38.7	female	1	cup dislocation patient with cerebral palsy	2XL/7.5°	cup				suff.	neutral
4	70.7	female	1	loosening cup + stem	3XL	cup + stem					
5	80.9	female	4	dislocation + cup loosening	4XL/7.5°	cup	dislocation			suff.	neutral
				dislocation	5XL	elevated rim inlay		suff.	46°	suff.	neutral
6	81.0	male	1	conversion of hemiarthroplasty	2XL/7.5°	cup				suff.	neutral
7	78.6	female	1	conversion of hemiarthroplasty	2XL/7.5°	cup				suff.	neutral
8	66.9	male	5	cup dislocation with osseous defect	4XL	cup				suff.	neutral
9	78.4	male	2	cup loosening with osseous defect	3XL/7.5°	cup				suff.	high
10	78.8	female	2	cup loosening with osseous defect	2XL	cup				suff.	neutral
11	72.9	male	2	cup loosening, with osseous defect	3XL/7.5°	cup + elevated rim inlay				suff.	neutral
12	62.6	female	1	cup loosening with osseous defect	3XL/7.5°	cup + elevated rim inlay				suff.	neutral
13	69.7	male	3	leg length discrepancy, removal of periarticular ossifications	4XL/7.5°			0°	43°	suff.	low
14	65.6	female	2	dislocation	5XL/7.5°		dislocation + stem revision	suff.	45°	suff.	neutral
15	69.1	male	5	dislocation	4XL		dislocation	0°	55°	0°	neutral
				dislocation	4XL/7.5°	elevated rim inlay		0°	55°	0°	neutral
16	72.5	female	1	dislocation	2XL/7.5°			suff.	44°	suff.	neutral
17	81.1	female	3	cup loosening with osseous defect	3XL	cup				suff.	neutral
18	56.1	male	2	cup loosening with osseous defect	4XL	cup				suff.	neutral

AT cup = anteversion of acetabular component, AT stem = antetorsion of femoral component, Incl. cup = inclination/abduction of acetabular component, Prev. surg. = Number of previous surgical interventions, suff. = sufficient.